U.S. and Soviet 'First-Strike' Capabilities

Nuclear war is a bluffing game somewhat like poker, a tense game with lots of betting and some reshuffling but, so far, no calls. If one is determined to play the game at all, the best strategy—and the only one compatible with survival—is to so thoroughly intimidate the opponent that one never actually plays one's hand.

This intimidation is called deterrence. By definition, it works only if nuclear weapons are never exploded in anger.

Deterrence

While most Western citizens support some form of deterrence, there are two quite different kinds of nuclear deterrence requiring two very different force structures. The deterrence most people support is already possessed in abundance by both superpowers. In fact, either side could unilaterally reduce its arsenal by more than half with no fear of losing it. It is the other kind of deterrence that drives the arms race.

The first kind of deterrence is nuclear deterrence of **nuclear** war. All it requires is the ability to retaliate after suffering the enemy's worst possible nuclear attack. In the *Department of Defense Annual Report* for 1979, Defense Secretary Harold Brown stated, "It is essential that we retain the capability at all times to inflict an unacceptable level of damage on the Soviet Union, including the destruction of a minimum of 200 major Soviet cities." Some 92 million citizens live in the 200 largest Soviet cities. It is usually assumed that 400 warheads, averaging 500 kilotons each, would kill them all. According to the figures in Table 1, such a force amounts to only 1.7% of the warheads in the U.S. arsenal 2.7% of the arsenal's total explosive power. Even that small fraction of the U.S. arsenal is probably far greater than what is needed to deter an unprovoked nuclear attack on the United States.

Since the most devastating attack the Soviet Union could possibly launch would leave the United States with more than 5,000 nuclear warheads, the adequacy of U.S. forces for this kind of deterrence has never been in doubt. Most of our existing nuclear weapons and all of our new ones are intended for the other kind of deterrence.

"Extended" Deterrence

The other kind of deterrence is nuclear deterrence of **conventional** war. According to the Pentagon theory which justifies the latest new weapons, this kind of deterrence requires that we make a credible threat to **start** a small nuclear war and keep it localized and one-sided by maintaining a first-strike threat against the Soviet Union itself. Since there is no possibility whatever of the Soviet Union waging conventional war overseas from its own borders, the location of this conventional war turned nuclear (which we hope to deter from happening) is always assumed to be Europe or Asia. Because America needs no such protection for itself, this second kind of deterrence is designed to protect America's overseas allies.

Although no sane person advocates that the United States should start a nuclear war the way the Japanese started World War II at Pearl Harbor, every American president since Truman has maintained a nuclear first-use option for overseas battlefield situations. Essentially, the first-use option means using American nuclear weapons to stop Russian tanks. The main problem with starting a nuclear war in that fashion is that the Russians can now retaliate in kind, using their own battlefield nuclear weapons.

According to the Pentagon's theory of "escalation dominance," the best way for us to force the Russians to back down rather than match us in nuclear escalation is by having the ability to destroy most of the Soviet nuclear weapons in a first-strike attack against Soviet missile silos, airfields, submarines, command posts, and nuclear weapon storage facilities. The ability to do that successfully is called a first-strike capability.

(Contrary to popular myth, there is no defense against nuclear weapons. They cannot be shot down as they are coming in. If nuclear weapons are going to be destroyed by military force, they must be destroyed before they are launched.)

A first-strike capability is the ability of one side to attack the other with such devastating force that the nation suffering the attack loses its ability to retaliate. In theory, a first-strike capability would permit a nation to start a nuclear war without committing national suicide. A successful first strike could start World War III and end it the same day—on terms favorable to the side that started it.

For the first twenty years after World War II, the United States **had** such a first-strike capability, largely because of an American head start in the nuclear arms race and because of the primitive technology of nuclear weapon delivery systems. In 1957 General Curtis LeMay, commander of the U.S. Strategic Air Command, explained how the first-strike option worked in the bomber age: "If I see that the Russians are amassing their planes for an attack, I'm going to knock the s--t out of them before they take off the ground."

General LeMay's plan was to use American bombers to drop nuclear bombs on Russian bombers while the Russian bombers were still on the ground. The modern equivalent of that plan is to use American missiles to drop nuclear warheads on Russian missiles while the Russian missiles are still in their underground shelters. Neither plan has ever been tested under realistic conditions, of course, but optimistic speculations about how a first-strike missile attack might work are the chief driving force behind the arms race. What we call the nuclear arms race is primarily a race to design and build equipment which enhances one's own first-strike capability and diminishes the other side's.

Today's Policy

Official acknowledgement of a U.S. first-use/first-strike policy is usually disguised in obscure Pentagon jargon, but the President's Commission on Strategic Forces was unusually forthright in its 1983 report. It stated, "The Soviets must continue to believe what has been NATO's doctrine for three decades: that if we or our allies should be attacked—by massive conven-

ENTIRE U.S. NUCLEAR ARSENAL—1983 Table 1	Warhead Numbers			Yield in Kilotons also Fallout Area in Square Miles		Potential Urban Destruction Area in Square Miles		Accuracy
	Weapons Deployed	Warheads per Weapon	Total Warheads	per Warhead	Total	per Warhead	Total	Median Miss Distance in Feet
Strategic Triad (Land, Sea, & Air)								
Intercontinental Ballistic Missiles (ICBMs)								
Titan II	49	1	49	9,000	441,000	108	5,300	4,864
Minuteman II	450	1	450	2,000	900,000	40	17,858	2,067
Minuteman III-12	257	3	771	170	131,070	8	5,915	730
Minuteman III-12a	293	3	879	335	294,465	12	10,600	730
Sub-total	1,049		2,149		1,766,535		39,673	
Submarine-Launched Ballistic Missiles (SLBMs)								
Poseidon	320	10	3,200	40	128,000	3	9,357	1,520
Trident (C-4)	200	8	1,600	100	160,000	5	8,618	1,520
Sub-total	520		4,800		288,000		17,975	
Intercontinental Bombers								
B-52 (with bombs)	272	4	1,088	1,000	1,088,000	25	27,200	
(plus SRAM missiles)			1,150	200	230,000	9	9,832	1,216
(plus Cruise missiles)			276	200	55,200	9	2,360	304
FB-111A (with bombs)	56	2	112	1,000	112,000	25	2,800	
Sub-total	328		2,626		1,485,200		42,192	
Triad Total	1,897		9,575		3,539,735		99,840	
Non-Triad Weapons (Tactical Plus Other Strategic)								
Strategic Air Defense Weapons								
Genie	240	1	240	1	240	.25	60	
Nike Hercules	100	1	100	10	1,000	1.2	116	
Sub-total	340		340		1,240		176	
Antisubmarine Weapons								
Depth Charges	652	1	652	10	6,520	1.2	757	
SUBROC	276	1	276	5	1,380	.75	202	
ASROC	2,464	1	2,464	1	2,464	.25	616	
Sub-total	3,392		3,392		10,364		1,575	
Intermediate—Range Nuclear Forces (INF)								
B-43 Bombs	2,160	1	2,160	1,000	2,160,000	25	54,000	
B-61 Bombs	2,900	1	2,900	500	1,450,000	16	45,672	
Sub-total	5,060		5,060		3,610,000		99,672	
Battlefield Weapons								
Pershing IA Missile	300	1	300	400	120,000	14	4,072	
Lance Missile	950	1	950	100	95,000	5	5,117	
Artillery Shells	4,000	1	4,000	2	8,000	.4	1,587	
Atomic Demolition Mines	300	1	300	100	30,000	5	1,616	
Sub-total	5,550		5,550		253,000		12,392	
Non-triad Total			14,342		3,874,604		113,815	
USA Grand Total			23,917		7,414,339		213,655	

Explanation of terms: Yield and Fallout Area—By coincidence, the size of the land area whch receives a lethal dose of prompt radioactive fallout is approximately equal to one square mile for each kiloton of the warhead's explosive yield. A lethal dose is defined as 450 rads of radiation accumulated during the first four days.

Urban Destruction Area—Defined here as the area subjected to more than 5 psi overpressure, which is sufficient shock force to demolish a non-reinforced brick building or house. It is also the potential firestorm area. The warhead is assumed to explode on the ground.

Median Miss distance—For identical weapons fired at any set of targets, half the warheads will land closer to the target than the median miss distance, and half will land farther away, at least in theory. Accuracy figures are taken from CRS Report 83-153S (see below); the report calls them CEP, for circular error probable. The term CEP is not used in the text or tables here for two reasons, one aesthetic and one practical. CEP sounds unnecessarily technical, and its meaning is not intuitively obvious. It is also potentially confusing because the Air Force definition of CEP differs from the definition used by statisticians. Median miss distance is equivalent to the Air Force definition of CEP; both assume zero bias error.

For comparison: The land area of the contiguous 48 states of the U.S.A. is 3,600,000 square miles. The land area of the U.S.S.R. is 8,600,000 square miles. Europe, excluding the U.S.S.R., is 1,900,000 square miles in area. Notice that each superpower arsenal has a lethal fallout area of over seven million square miles. The central-city areas of America's 30 largest cities occupy only 6,000 square miles, home to 34 million people. The 60 million suburbanites of these 30 cities occupy another 55,000 square miles. Each side can demolish and burn over 200,000 square miles of urban real estate.

tional means or otherwise—the United States has the will and the means to defend with the full range of American power . . . [Thus] effective deterrence requires that early in any Soviet consideration of attack, or threat of attack, with conventional forces or chemical or biological weapons, Soviet leaders must understand that they risk an American nuclear response."

In order to deter the Russians from using the same first-use strategy against us, or from retaliating after we use it against them, the report goes on to say, "we must be able to put at risk those types of Soviet targets—including hardened ones such as military command bunkers and facilities, missile silos, nuclear weapons, and other storage and the rest—which the Soviet leaders have given every indication by their actions they value most." In other words, we need a first-strike capability to give credibility to a long-standing policy of first use.

This means that for the U.S. to have the second kind of deterrence, the Soviet Union must be denied the first kind. As Secretary of State Alexander Haig stated it in 1982, "Let us remember first and foremost that we are trying to deter the Soviet Union, not ourselves." Conservative defense analyst Colin Gray put it this way in 1980: "the West needs to devise ways in which it can employ strategic nuclear forces coercively, while minimizing the potentially paralyzing impact of self-deterrence." It stands to reason that if the Russians can deter us from starting a nuclear war, then we cannot use nuclear weapons to deter them from starting a conventional war.

The Danger

The chief liability in building a first-strike nuclear force today, in the missile age, is that its very existence could start a nuclear war. General LeMay's bombers may have been able to destroy the Soviet Air Force on the ground in 1957, but the Russians now have an option they didn't have then—they can launch first even though it would be suicidal. If they fear that a U.S. first strike is imminent, they might prefer to launch their missiles rather than have them destroyed in the ground. That way, they can at least make certain that Russia does not die alone.

This point bears repeating. Even if the United States acquires a missile-age first-strike capability every bit as effective on paper as the bomber-age first-strike capability that General LeMay boasted about in 1957, the Russians can still strike first and destroy the United States. They could do so even if they never came close to acquiring an "unanswerable" first-strike capability of their own. You don't need a first-strike capability in order to strike first. All you need are nuclear weapons and fear.

In the missile age, when both sides already have their forces amassed for attack 24 hours a day, first-strike weapons on one

side create a "use-them-or-lose-them" mentality on the other side. For that reason, first-strike weapons are said to be "crisis-destabilizing." Their existence decreases the security of both sides, regardless of which side owns them. If either side approaches a first-strike capability, both sides are likely to become trigger-happy from a deadly combination of fear and temptation. In that kind of atmosphere a faulty computer chip could start World War III.

You might think that if both sides have a first-strike capability, crisis stability will be restored. Nothing could be further from the truth. If both sides have a theoretical first-strike capability, it merely doubles the incentives on both sides to strike first. It doubles the destabilizing effect. Each side will be faced with the possibility of victory if it strikes first and the certainty of defeat and destruction if it doesn't.

This fact leads to the most difficult conclusion of the nuclear arms debate, namely that parity in first-strike weapons is not a desirable goal and, in fact, that with first-strike weapons inferiority is **better** than parity. The fewer first-strike weapons we have, the less likely we are to be destroyed.

Nuclear Poker

Nuclear war is still a bluffing game. Nobody is firing off any missiles yet. Both players at nuclear poker are still drawing cards for a better hand and raising the ante, with one side trying for a royal flush and the other going after four aces. Both players know that if either side plays its hand the game is over, in every sense of the word. The only way one side can win is for the other side to quit while everybody is still alive.

And yet, bluffing games must be based on credible capabilities—capabilities which in this case are demonstrated by the ownership of first-strike hardware. Hence, the nuclear arms race.

Since no one knows what a first-strike attack would really be like, the procurement process has long since become dependent on mathematical simulations. Computers are programmed to play nuclear war as if nuclear war were a chess game. People who suffer from math anxiety have tended to withdraw from the national strategy debate and let experts with elecronic brains order the next round of very real, very deadly hardware for more imaginary games.

But if war is too important to be left to the generals, then human annihilation is too important to be left to cold war ideologues and computer programmers. In a very real way, the survival of our society may depend on the willingness of the millions of citizens who have at least modest mathematical ability to take the time to learn the rules of nuclear war.

ENTIRE SOVIET NUCLEAR ARSENAL—1983

Table 1

	Warhead Numbers			Yield in Kilotons also Fallout Area in Square Miles		Potential Urban Destruction Area in Square Miles		Accuracy
	Weapons Deployed	Warheads per Weapon	Total Warheads	per Warhead	Total	per Warhead	Total	Median Miss Distance in Feet
Strategic Triad (Land, Sea, & Air)								
Intercontinental Ballistic Missiles (ICBMs)								
SS-11	550	1	550	1,000	550,000	25	13,750	3,648
SS-13	60	1	60	600	36,000	18	1,067	6,080
SS-17-1	30	4	120	750	90,000	21	2,476	1,459
SS-17-2	10	1	10	6,000	60,000	83	825	1,398
SS-17-3	110	4	440	500	220,000	16	6,930	1,216
SS-18-1&3	16	1	16	20,000	320,000	184	2,947	1,155
SS-18-2	92	8	736	900	662,400	23	17,152	1,398
SS-18-4	200	10	2,000	500	1,000,000	16	31,498	851
SS-19-1	80	6	480	550	264,000	17	8,055	1,277
SS-19-2	10	1	10	10,000	100,000	116	1,160	851
SS-19-3	240	6	1,440	550	792,000	17	24,166	912
Sub-total	1,398		5,862		4,094,400		110,028	
Submarine-Launched Ballistic Missiles (SLBMs)								
SS-N-5	57	1	57	2,000	114,000	40	2,262	9,120
SS-N-6	384	1	384	1,000	384,000	25	9,600	4,256
SS-N-8	292	1	292	1,000	292,000	25	7,300	4,864
SS-N-17	12	1	12	500	6,000	16	189	4,560
SS-N-18	224	5	1,120	500	560,000	16	17,639	3,040
Sub-total	969		1,865		1,356,000		36,990	
Intercontinental Bombers								
TU-95 Bear	100	1	100	1,000	100,000	25	2,500	
MYA-4 Bison	45	1	45	1,000	45,000	25	1,125	
TU-26 Backfire	100	2	200	1,000	200,000	25	5,000	
Sub-total	245		345		345,000		8,625	
Triad Total	2,612		8,072		5,795,400		155,643	
Non-Triad Weapons (Tactical and Other Strategic)								
Anti-Ballistic Missiles (ABMs)								
Galosh	32	1	32	100	3,200	5	172	
Strategic Air Defense								
SA-1, 2, 3, 5	1,000	1	1,000	10	10,000	1	1,160	
Antisubmarine Weapons								
Depth Charges	100	1	100	10	1,000	1	116	
SS-N-14, 15; SUW-N-1	340	1	340	15	5,100	2	517	
Sub-total	440		440		6,100		633	
Antiship Weapons								
Bombs	35	1	35	1,000	35,000	25	875	
SS-N-3, 19; AS-4	471	1	471	350	164,850	12	5,848	
SS-N-7, 9; AS-6	308	1	308	200	61,600	9	2,633	
Sub-total	814		814		261,450		9,356	
Intermediate-Range Nuclear Forces (INF)								
SS-4	275	1	275	1,000	275,000	25	6,875	
SS-5	35	1	35	1,000	35,000	25	875	
SS-20	300	3	900	150	135,000	7	6,352	
SS-N-5	39	1	39	1,000	39,000	25	975	
Tu-26, 22, 16	2,250	1	2,250	1,000	2,250,000	25	56,250	
Sub-total	2,899		3,499		2,734,000		71,327	
Battlefield Weapons								
Short-range	940	1	940	15	14,100	2	1,429	
Medium-range	70	1	70	1,000	70,000	25	1,750	
Sub-total	1,010		1,010		84,100		3,179	
Non-triad Total			6,795		3,098,850		85,827	
Soviet Grand Total			14,867		8,894,250		241,470	

Sources: Triad figures are taken from Congressional Research Service Report No. 83-153S, "U.S./Soviet Military Balance: Statistical Trends 1970-1982 (As of January 1, 1983)," by John Collins. Other figures are taken from *Scientific American*, November 1982, "A Bilateral Nuclear-Weapons Freeze," by Randall Forsberg. Stockpile estimates do not include spares or weapons not deployed.

First-Strike Calculations

Ironically, the morality of a nuclear weapon is related to its accuracy, with greater accuracy making a weapon less moral. The reason is that greater accuracy is more likely to cause a nuclear war to start.

This bizarre relationship between ethics and technology means that people who march in the street for peace should also learn to talk about ballistic impact points, miss distances, and kill probabilities. If they don't, they risk being treated as a colorful side-show to an ongoing arms race that threatens the planet.

For the millions of people who do **not** suffer from math anxiety, and especially for those with modest technical training, the basic formulas for nuclear missile evaluation are given below. They show how accuracy improvements enhance first-strike capability.

Four items of information are needed to calculate the first-strike effectiveness of a missile. They are the warhead explosive yield (Y), the target hardness (H), the median miss distance (MMD), and the warhead reliability (WR). The outline below shows how these four quantities are combined to determine the overall kill probability (OKP) of any warhead from a missile which is successfully launched. The formulas accompany the outline.

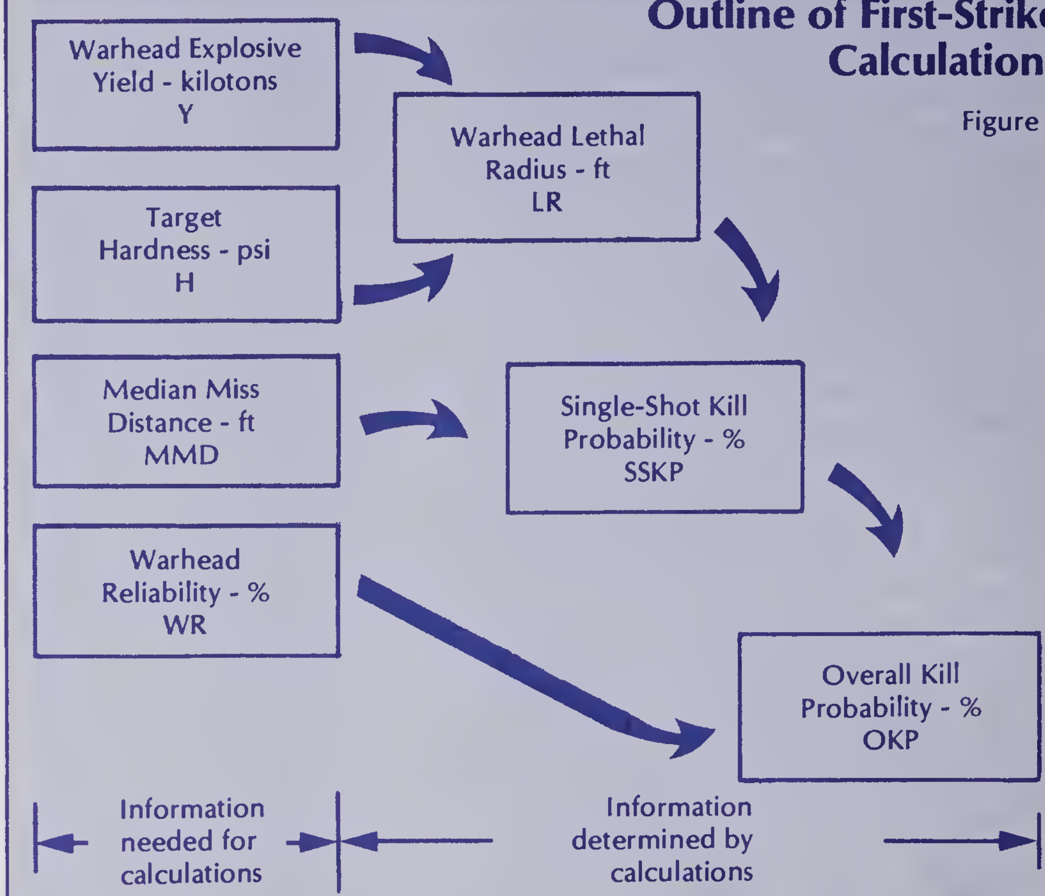
Notice that the lethal radius (LR) of a nuclear warhead is a function of both warhead yield and target hardness (equation 1). For example, the lethal radius of a 335 kiloton MX missile warhead against a target hardened to withstand a 2,000 pound per square inch (psi) shock wave is 827 feet. The lethal radius of the same warhead against brick houses, which can withstand only 5 psi, is almost two miles. (A different formula is used for 5 psi).

One way for a defender to reduce the effectiveness of enemy warheads is to increase target hardness by adding concrete and steel to missile silos. An attacker can then nullify the defender's improvements in target hardness by two methods. The easiest way is to increase warhead yield, in other words to make a bigger explosion. By far the most efficient way, however, is to increase missile accuracy (decrease the miss distance).

Every warhead will miss its target by some distance. If the miss distance is small enough, the target will be destroyed by the explosion of the warhead. This will happen whenever the miss distance is less than the warhead's lethal radius against that particular target.

Outline of First-Strike Calculations

Figure 1



Equation 1 $LR = 1500 \bullet \sqrt[3]{Y/H}$ ft, for Y kt and H psi, H > 1000

2 $SSKP = 1 - .5^{x^2}$, where

3 $x = LR/MMD$, for LR ft and MMD ft

4 $OKP = WR \bullet SSKP$

5 $OKP_{2\text{-on-}1} = 1 - (1 - OKP)^2$

The exact miss distance for any single arriving warhead is not predictable, but, theoretically, the median miss distance for a large number of similar warheads is. Unclassified estimates of median miss distances for all U.S. and Soviet missiles are published regularly. It is the *ratio* of lethal radius to the median miss distance which determines single-shot kill probability (SSKP). See equations 2 and 3.

Single-shot kill probability is defined as the likelihood that a reliable warhead from a reliable missile will destroy its target. Because it is easy to calculate, it is widely used as a measure of weapon capability, even though two of the quantities used to calculate it, target hardness and median miss distance, are quite impossible to estimate with any great confidence.

The only way to realistically measure target hardness is to explode a nuclear weapon at ground level near a missile silo and then see if the missile inside it can still be fired when the dust clears. Such tests are prohibited by treaty. Mathematical simulations based on scale model tests are used instead, but they are not the same thing. Median miss distances are calculated on the basis of actual missile test flights, but the tests are conducted under controlled conditions that do not necessarily resemble combat conditions and combat flight routes.

It is rarely mentioned in public discussions that warhead reliabiilty must be considered in calculating the more useful quantity, overall kill probability (OKP). See equation 4. As defined here, warhead reliability includes re-entry reliability. It means the likelihood that a warhead from a flawlessly launched missile will actually survive re-entry and explode near its target. For calculation purposes it is usually assumed to be 95%, although it is now admitted that as many as 70% of

the early Polaris warheads were defective and could not have exploded.

Another kind of reliability problem is missile reliability. Missile launch failures can be observed by the launching crews and reported. If there are spare missiles with rapid retargeting capability, they can be launched as replacements to cover the targets of the missiles observed to fail in their silos or early in flight. Once again, there is no way to estimate missile reliability with confidence. For calculation purposes it is often assumed to be 80%. If said reliability is assumed to be 80%, only 80% of a given missile force can be fired in the initial attack. The other 20% must be held back for immediate use as spares.

Thanks to the use of multiple warheads on missiles, each superpower now has more warheads than the other side has missiles. Two-on-one targeting is usually assumed, two warheads aimed at each enemy missile silo. See equation 5.

Now we have everything we need to determine (on paper) the first-strike potential of a given force of missiles. Take, for example, 100 MX missiles. We assume:

Y = 335 kt
H = 6000 psi (superhard Soviet silo)
MMD = 304 ft
WR = 95%

We can use these assumptions to calculate that:
LR = 573 ft
SSKP = 91.5%
OKP = 86.9%
$OKP_{\text{2-on-1}} = 98.3\%$

If missile reliability is assumed to be 80%, only 80 MX missiles will be launched successfully, carrying 800 warheads. Two-on-one targeting will allow 400 targets to be attacked, of which 393 (98.3%) will be destroyed and 7 will survive.

These calculations apply only to missiles aimed at fixed targets on land. Entirely different considerations are used in evalating the first-strike threat to bombers in the air and to missile submarines at sea.

Note: Real nuclear war planners add various "fudge factors" to these simple equations, greatly increasing the complexity of the calculations without significantly changing the results.

Scorekeeping

The tables and graphs in this paper show how U.S. defense analysts evaluate the cards in a hand of nuclear poker. They demonstrate that most of the criteria now used by the public in assessing the nuclear balance are not relevant. Isolated factors such as missile size, warhead yield, age, or the number of weapons are not what count. What does count is weapon survivability, an attribute based on the theoretical "kill probability" of the enemy's weapons.

The formulas used here for calculating kill probability are simpler than they look at first. [See box: First-Strike Calculations] They are complicated enough to appear far more sophisticated and credible than they really are and at the same time simple enough to allow absurdly precise calculations to be made on the basis of vague hypothetical data. They are, nonetheless, the accepted rules of scorekeeping in the nuclear bluffing game.

When these formulas are applied to published stockpile estimates, one conclusion is inescapable. In a nuclear war both superpowers would be destroyed. As the fictional WOPR computer discovered, in the 1983 movie *WarGames*, there are no winners, and the only winning move is not to play.

Even using the accepted kill probability formulas, which no doubt exaggerate the effectiveness of first-strike weapons, neither side is anywhere near having a first-strike capability. For the foreseeable future, neither side has any prospect of getting far enough ahead to matter. The goal of the arms race—first-strike capability—is a will 'o the wisp. In practical terms, it simply can never be attained.

Race to Oblivion

The futile struggle to attain it is nonetheless dangerous. It is dangerous because each new weapon is a provocation which must be answered for political reasons, and each answer is a further provocation. This action-reaction cycle creates a procurement subculture which is potentially as destabilizing as the weapons themselves. Each side must constantly villify the other to justify new weapons, until a mentality is created which is like the mentality of nations at war. In a world armed with nuclear missiles, the mentality of war is only a hair's breadth away from war itself.

And finally, the first-strike arms race is dangerous because it may delude war planners into believing their own propaganda. Nuclear weapons are already being aimed at missile silos. Each side might think the other has a workable plan; or it might suspect that the *other* side thinks it has a workable plan. The enormous objective stability of the nuclear balance, with no side having any realistic prospect of advantage, may be nullified by subjective fears and temptations.

If we prepare for a first-strike against Russia, and they prepare for a first-strike against us, war could well become inevitable even though both societies' chance for survival remains zero.

Table 2

New Weapons for the 21st Century Nuclear Arsenals—Possible New Deployments by 1996	Total Warheads	Yield per Warhead - kt	Median Miss Distance - ft	Lethal Radius* - ft	Single Shot Kill Probability - %
U.S.A. Missiles					
Pershing II	108	200	122	696	100.0
Cruise (ground)	464	500	61	945	100.0
MX	1,000	335	304	827	99.4
Cruise (sea)	400	200	304	696	97.4
Cruise (air)	2,880	200	304	696	97.4
Trident II (D-5)	2,688	475	426	929	96.3
Midgetman	1,000	475	426	929	96.3
U.S.S.R. Missiles					
SS-19-X	2,160	550	486	975	93.9
SS-18-X	2,840	500	486	945	92.7
SS-X	4,200	500	486	945	92.7
SS-17-X	600	750	608	1,082	88.9

*Calculated for targets hardened to withstand 2,000 psi shock pressure.

Source: *Modernizing U.S. Strategic Offensive Forces: The Administration's Program and Alternatives*, Congress of the United States, Congressional Budget Office, May 1983.

Some sources have suggested that as many as half of the Soviet missile silos have been superhardened to withstand 6,000 psi, and that 26,000 psi hardness is possible. Some critics doubt these claims, but in a sense they are irrelevant. The United States should not aim warheads at Soviet missile silos in the first place. Furthermore, missiles with the expected accuracies of Pershing II have 98% single-shot kill probabilities even against 26,000 psi targets. Extreme accuracy can overcome any target hardening scheme.

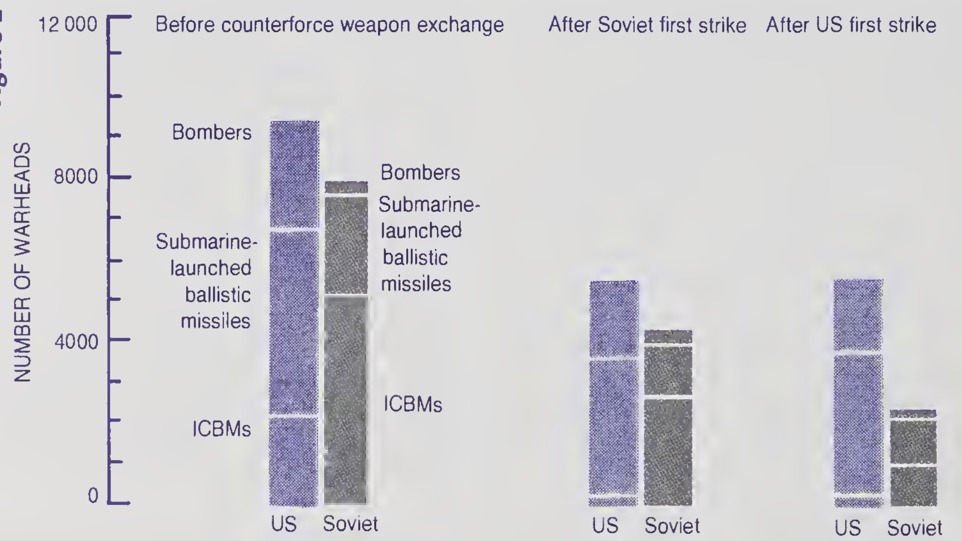
Those "aging" nuclear weapons

The U.S. nuclear arsenal is not wearing out. It is well maintained. A twenty year-old one megaton bomb will still dig a hole in the ground the size of Yankee Stadium and flatten every building inside a 25 square mile area. All of our missiles are zero-mileage missiles. Bombers do fly in peacetime, but an airplane can be kept airworthy forever by routine maintenance and parts replacement. Entire wings are replaceable. Only a nuclear-powered submarine must be rebuilt from scratch. (After 20 or 30 years the submarine hull and pipes become salt-corroded and fatigued. In addition, pipes and walls in the reactor compartment become so radioactive that replacement of the reactor would expose shipyard workers to high doses of radiation.)

Maintenance should not be confused with modernization. Maintenance and replacement keep the weapons potent; the goal of modernization, on the other hand, is to increase first-strike capability by increasing the accuracy of weapon delivery systems. The arms race is not a maintenance race; it is a modernization race.

"Warhead sounds so negative. Let's call it a nuclear peacehead."

Figure 2



The ultimate goal of the nuclear arms race is to acquire the ability to pre-emptively destroy all of the enemy's nuclear weapons. Figure 3 on page 7 illustrated the present and future first-strike kill probabilities of missiles aimed at fixed targets on land (such as missile silos). Figure 2 above adds long-range bomber and submarine forces to these targets and shows how many "strategic triad" warheads would be expected to survive a first strike. *(The relevant question is not how many enemy weapons are destroyed, but how many survive to be used in retaliation.)*

The left pair of bars shows the strategic balance in 1983; the score stands at 9,500 U.S. and 8,000 U.S.S.R. The middle pair of bars shows the score after the worst possible Soviet first strike, one which virtually wipes out the U.S. ICBM force. After killing as many as 20 million Americans with radioactive fallout alone, the Russians are still facing 5,500 U.S. warheads on submarines at sea and bombers in the air, not to mention thousands of non-triad or "tactical" nuclear weapons in Europe.

The right pair of bars shows the score after a U.S. first strike. Because a higher percentage of Soviet weapons are based on land, Soviet strategic forces are more vulnerable than U.S. forces even though a greater percentage of Soviet ICBMs might survive an attack. Since any first-strike threat to missile silos is potentially more damaging to overall Soviet forces than to U.S. forces, the Soviets may have put more effort into hardening missile silos with extra steel and concrete. This analysis assumes that Soviet and American missile silos have the same hardness rating, 2000 psi.

Chart reprinted from *Physics Today*, January 1983, "The Freeze and the Counterforce Race," by Harold Feiveson and Frank von Hippel.

WordGames

The term "first strike" in its naked form is used by defense officials when talking to each other, by peace activists, and increasingly by the press. Official statements to the public always employ euphemisms for first strike such as: counterforce, countervailing strategy, hard-target kill potential, counter-silo capability, strategic anti-submarine warfare, escalation dominance, damage limitation, strategic force modernization, and others. Watch for a new euphemism every six months. We use the term "first strike" here in reference to any capability to locate and destroy enemy nuclear weapons before they can be used.

Sources of Quotation in the Text

"It is essential . . . " —Harold Brown, *Department of Defense Annual Report Fiscal Year 1979*, January 1978, p. 55.

"If I see that . . . " —Curtis LeMay quoted in Fred Kaplan, *The Wizards of Armageddon*, Simon and Schuster, 1983, p. 134.

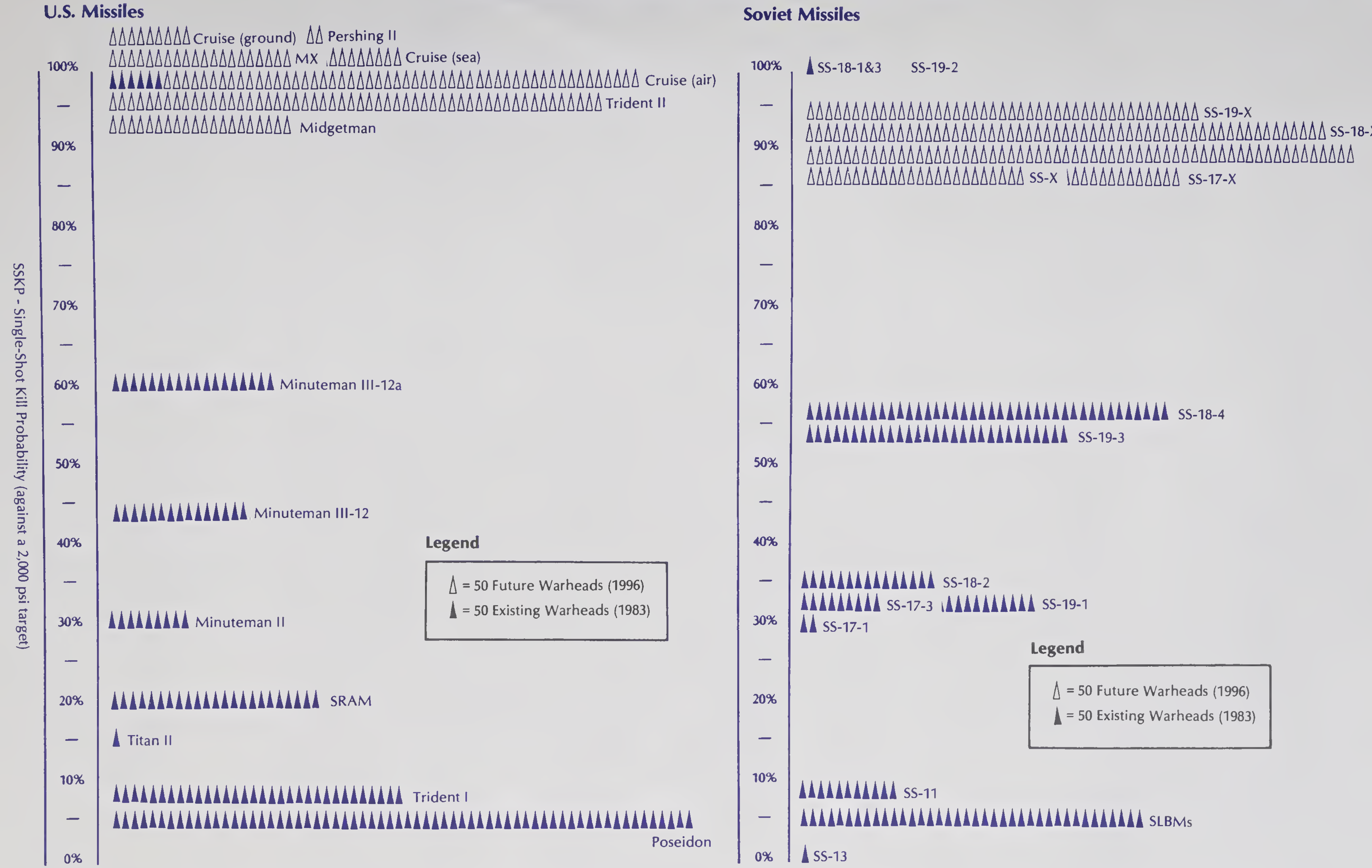
"The Soviets must continue . . ." —*Report of the President's Commission on Strategic Forces*, The Pentagon, April 1983, pp. 5, 6.

"Let us remember . . . " —Alexander Haig speech transcript published in *New York Times*, April 7, 1982.

"the West needs to devise . . . " —Colin S. Gray and Keith Payne, "Victory is Possible," *Foreign Policy*, Summer 1980, p. 14.

First-Strike Effectiveness Against Fixed Military Targets

Figure 3



The object of the missile modernization race is to acquire several thousands of warheads with better than 80% single-shot kill probability against hardened targets. Neither side is doing very well today, a fact which makes the nuclear balance of terror relatively stable. That stability could be seriously eroded by the year 1996, as both superpowers increase the accuracy of their missiles. A nuclear weapon freeze would stop this race, but the "build-down" alternative popular with hawks would allow it to continue.

The charts above show how military planners count the score in the missile race. For example, the U.S. has 450 Minuteman II warheads, each with a 31% single-shot kill probability against a hardened target (2000 psi). If all 450 were launched, assuming perfect warhead and missile reliability (no duds and no misfires), only 31% would land close enough to destroy hardened targets. Note that every warhead depicted here could land close enough to destroy a city, giving it a 100% single-shot kill probability against urban targets. Any 8 symbols on either chart (= 400 warheads) represent enough explosive power to kill the urban population of the other superpower.

Only the threat to land-based targets is shown here. Figure 2 on page 6 shows the total threat to strategic land, air, and sea targets. Table 2 on page 5 shows the future weapons in more detail.

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